

**REMARKS**

**1. Claim Rejections - 35 U.S.C. § 103**

Claims 1, 4, 10, and 12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 3,828,133 to Ishigami in view of U.S. Patent No. 6,229,634 to Smith. Applicant respectfully requests withdrawal of this rejection for at least the following reasons.

As previously stated, claim 1 recites a device for increasing the perceived bandwidth in an audio signal path with limited bandwidth. The claimed device includes a splitter adapted to divide the audio signal path from an input terminal into two branches. The first branch passes a first part of the audio signal, and the second branch processes a second part of the audio signal. As claimed, the second branch comprises a harmonic generator for producing out-of-band harmonics of the audio signal. Claim 1 further recites a combiner for adding the out-of-band harmonics from the second branch to the first part of the audio signal from the first branch. One advantage of the claimed invention is that by adding out-of-band harmonics to the audio signal, a device with limited bandwidth is able to enhance the quality of the resultant audio signal without increasing the bandwidth or memory size of the device.

The Examiner now contends that while the combination of Ishigami and Smith fails to disclose adding out-of-band harmonics to an audio signal, it would have been *obvious to try* adding out-of-band harmonics to the signal with reasonable expectation of success in order to produce an improved sound. Applicant respectfully submits that for at least the reasons below a person of ordinary skill looking at the cited references at the time of the invention would not have added out-of-band harmonics to a signal in order to obtain an improved sound.

Ishigami discloses a speech quality improving system that divides a voice signal into two branches, generates higher harmonic components of one branched signal, and combines the harmonics with the other branched signal. The cited reference discloses the use of an instantaneous compressor and expander combination to produce the higher harmonic components of the input signal, such that the harmonic output is

proportional to the input (Fig. 4 and col. 3, ln. 68 to col. 4, ln. 8). According to Ishigami, a good proportional relationship between the level of the harmonic components and the level of the input signal is needed in order to develop a high quality signal that substantially approximates the original voice signal and thereby maintains the natural quality of the reproduced signal (see, e.g., col. 1, lns. 27-40 and col. 4., lns. 9-19). As evidenced by Equations (1) through (4), Ishigami maintains this proportional relationship by setting the compression ratio of the compressor to  $1/v$  and the expander characteristic of the expander to a  $v$ -th power characteristic (see col. 2, ln. 45 to col. 3, ln. 39).

Smith is directed to a burst mode optical digital receiver that up-converts the frequency of the output of an opto-electronic detector, amplifies the up-converted signal, and then down-converts the frequency of the amplified signal. As part of the amplifying means, a signal limiter reduces the range of output pulse amplitudes and protects the RF input to the down-conversion mixer from excessive power levels. An undesired side effect of using a signal limiter is the incidental production of out-of-band harmonics (see, e.g., col. 4, lns. 36-39). These harmonics must be attenuated after down-conversion to preserve signal quality (id.). Smith uses a low-pass filter 15 to remove the out-of-band harmonics, as well as any noise present in the signal outputted by the mixer 12 (see Fig. 5 and col. 4, lns. 55-56). In fact, it may be concluded, based on language in the reference, that Smith views the production of out-of-band harmonics as being as undesirable as noise (see, e.g., col. 3, lns. 15-18 and col. 4, lns. 55-56).

A claimed invention cannot be found obvious under §103 using the *obvious to try* rationale without "a finding that there had been a finite number of identified, predictable potential solutions to the recognized need or problem" at the time of the invention (MPEP 2143(E)). While the benefit of adding harmonics to a signal was recognized at the time of the invention, nothing in the prior art, as evidenced by Ishigami and Smith, identified the benefit of adding out-of-band harmonics to a signal. In fact, *Smith discourages the use of out-of-band harmonics* in that Smith teaches the elimination of out-of-band harmonics through the use of a filter in order to preserve signal quality. Furthermore, in Smith, the production of out-of-band harmonics is only an incidental and

undesirable side effect of using the signal limiter, much like the presence of noise at different stages of the receiver. Therefore, the prior art, as evidenced by the cited references, does not support a finding that the addition of out-of-band harmonics was an "identified, predictable potential solution" for improving sound quality at the time of the invention.

Even if the Examiner maintains that the addition of out-of-band harmonics was a known option, the cited references still fail to support an obviousness conclusion. Regardless of other findings, a claimed invention cannot be found obvious under §103 using the *obvious to try* rationale without "a finding that one of ordinary skill in the art could have pursued the known potential solutions with a reasonable expectation of success" at the time of the invention (MPEP 2143(E)). In the instant case, a person of ordinary skill in the art at the time of the invention could not have pursued the addition of out-of-band harmonics with a reasonable expectation of success, as explained below.

In order to add out-of-band harmonics to the input signal of Ishigami in accordance with the teachings of Smith, a skilled artisan would have to replace the instantaneous compressor-expander combination in Ishigami with the signal limiter in Smith. As Equations (1) through (4) of Ishigami illustrate, the compressor-expander combination requires careful calculations to ensure that the harmonic output level is proportional to the input signal level, so that the natural quality of the original voice signal may be preserved (see col. 3, Ins. 27-32 and col. 4, Ins. 9-19). Ishigami further indicates that a conventional nonlinear circuit fails to provide input and output signals with proportional levels and therefore, produces an output signal with insufficient natural quality (see Fig. 4; col. 3, ln. 58 to col. 4, ln. 8; and col. 1, Ins. 27-35).

There is no indication in Smith that the production of out-of-band harmonics by the signal limiter can be tailored to a specific level, as the signal limiter only incidentally produces out-of-band harmonics. Furthermore, Smith's only "control" over these out-of-band harmonics is the ability to eliminate them using a bandpass filter. Therefore, one of ordinary skill in the art could not reasonably expect the Smith signal limiter to produce a harmonic output level proportional to the input signal level and thereby, provide a reproduced voice signal of sufficient natural quality, as accomplished by Ishigami.

Accordingly, based on the cited references, it would not have been obvious to try adding out-of-band harmonics to an input signal, as there was no reasonable expectation of successfully reproducing a signal with sufficient natural quality using this method.

For the reasons stated above, claim 1 and all claims depending from claim 1 recite patentable subject matter.

Claims 2, 3, 6, and 7 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Ishigami in view of Smith, in further view of U.S. Patent No. 5,923,766 to Oda and in further in view of U.S. Patent No. 5,828,755 to Feremans. Withdrawal of this rejection for at least the following reasons is respectfully requested.

Oda is directed to an audio conversion circuit that compensates for low frequency audio components that are lower than the frequency a speaker can reproduce and are supplied to a speaker having poor low frequency response. Oda discloses the low frequency component of an input audio signal being filtered and extracted to generate even numbered harmonics. Secondary harmonics are extracted from these even numbered harmonics, amplified to an appropriate level, and then added to the original input signal.

Feremans discloses a method for improving and/or altering the quality of audio signals by isolating a number of signals from the input signals, generating higher harmonics of those isolated signals, amplifying the higher harmonics, and then combining the higher harmonics with either the original signal or a treated version of the original signal.

Claims 2, 3, 6, and 7 depend from claim 1. Neither Oda nor Feremans makes up for the above-described deficiencies in the proposed Ishigami and Smith combination. Therefore, claims 2, 3, 6, and 7 are allowable for at least the reasons set forth above.

Claim 5 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Ishigami in view of Smith, in further view of Oda and in further in view of U.S. Patent No. 6,865,430 to Runton. Withdrawal of this rejection for at least the following reasons is respectfully requested.

Runton is directed to an apparatus that may be provided in software as instructions to a digital signal processor for enhancing digital audio signals after

compression and decompression. Runton discloses receiving a digital decompressed audio signal and splitting the signal into two parts. One part of the signal is harmonically enhanced and the other part has warmth added to it. Both parts of the signal are then combined and frequency equalized to provide the digitally enhanced output signal.

Claim 5 depends from claim 1. Runton does not make up for the above-described deficiencies in the proposed Ishigami and Smith combination. Therefore, claim 5 is allowable for at least the reasons set forth above.

Claim 11 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Ishigami in view of Smith and in further view of U.S. Patent No. 6,606,388 to Townsend. Withdrawal of this rejection for at least the following reasons is respectfully requested.

Townsend is directed to a technique for enhancing audio signals generated from compressed digital audio files. The first two processing modules create harmonic sequences from the low frequency components and then the high frequency components contained in the original input signals. A third processing module adds and subtracts delayed and filtered versions of the enhanced input signal with itself to create left and right channeled stereo-like outputs.

Claim 11 depends from claim 1. Townsend does not make up for the above-described deficiencies in the proposed Ishigami and Smith combination. Therefore, claim 11 is considered allowable for at least the reasons set forth above.

Claims 8, 9, 13, and 14 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Ishigami in view of Smith and in further view of U.S. Patent Application Publication No. 2001/0034252 to Mousty. Withdrawal of this rejection for at least the following reasons is respectfully requested.

Mousty is directed to a ringing device for a portable telephone. Mousty discloses the use of an algorithm to add harmonics to the fundamental acoustic ring signal in order to produce a richer sound.

Claims 8, 9, 13, and 14 depend from claim 1. Mousty does not make up for the above-described deficiencies in the proposed Ishigami and Smith combination. Therefore, claims 8, 9, 13, and 14 are allowable for at least the reasons set forth above.

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Accordingly, reconsideration and withdrawal of all rejections under 35 U.S.C. § 103(a) is respectfully requested.

**2. Conclusion**

In light of the foregoing, it is respectfully submitted that the present application is in condition for allowance and notice to that effect is hereby requested. If it is determined that the application is not in condition for allowance, the Examiner is invited to initiate a telephone interview with the undersigned representative to expedite prosecution of the present application.

If there are any fees resulting from this communication, please charge same to our Deposit Account No. 18-0988, our Order No. SALBP0127US.

Respectfully submitted,

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